Developing Routinized Information Processing Capabilities for Operational Agility: Insights from China

Completed Research Paper

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Abstract

Operational agility, which reflects the agile practices at business process level, is increasingly deemed as a significant determinant of business success in a turbulent business environment. Despite its importance, how operational agility can be attained is not answered by existing research. Drawing on the classic organization theory—information processing view of firms, the main contribution of this study is that it provides a process model of developing routinized information processing capabilities for operational agility in a turbulent business environment which fulfills this theoretical gap. It indicates the significant roles played by IT-enabled information processing networks and organizational controls during the process. It also identifies three routinized information processing capabilities including information sensitivity, information fluidity, and information decomposability. This is achieved by conducting a case study of Haier, one of the largest producers of household appliances in China. This paper concludes with a discussion of potential theoretical and practical contributions.

Keywords: Operational agility, information processing capability, case study

Introduction

Enterprise agility, which is viewed as a significant determinant of business success in a turbulent business environment (Sull 2009), consists of three interrelated capabilities: customer agility, partnering agility, and operational agility (Sambamurthy et al. 2003). While different types of agility center on different aspects of firm's activities, this study pays unique attention to operational agility, which reflects agile practices at business process level (Sambamurthy et al. 2003). The reasons we choose operational agility are three folds: (1) the modern business environment necessitates operational agility (Sambamurthy et al. 2003); (2) uncertainty that is rooted in the nature of business process (Mani et al. 2010) requires firms to be agile operationally; (3) operational agility is especially crucial for firms relying heavily on their business processes in competition, such as manufacturing firms (e.g. Kim and Lee 1993; Voss 1995).

Furthermore, operational agility should be considered as of particular importance in China. On one hand, since China's admission to the World Trade Organization (WTO) in November 2001, the competitive environment in China has become increasingly complex and turbulent (Tsui et al. 2004). While thousands of multinationals that have ambitious growth in revenues from China entered Chinese market on a grand scale, local Chinese competitors with a sharp growth rate have raised the biggest challenge to multinationals (Williamson and Zeng 2004). Meanwhile, Chinese consumers' preference has been continuously changing over the past ten years, from purchasing low-end or premium products to purchasing good-enough products (Gadiesh et al. 2007). Furthermore, the transition from a centrally planned economy to a market economy constantly challenges the political system governing the economy (Tsui et al. 2004), which results in frequent changes in government regulations. All the conditions lead to a turbulent business environment in Chinese market. Thus business success in China demands the ability to sense and respond to rapid change (Paine 2010), which can be achieved through agile utilization of firm's business process. One the other hand, operational agility contributes to business success of manufacturing firms largely. As a "world's factory", manufacturing currently makes up around 47 percent of China's gross domestic product (GDP). It is beneficial for numerous manufacturing firms in China to achieve operational agility so that they are capable to sense and respond to customer demand from all over the world in an efficient and effective manner. Therefore, to compete in Chinese market, it is indispensable for firms to attain operational agility that allows them to move fast and accurately.

As its vital role in enabling business success, the concept of operational agility has garnered considerable research attention over the past five years (e.g. Alexopoulou et al. 2008; Raschke 2007; Raschke and David 2005; Seethamraju and Seethamraju 2009; Tallon 2008; Wu and Li 2008). The majority of operational agility research centers on examining the antecedence of operational agility. Yet, despite the growing body of research, an important question has not been answered: how to achieve operational agility? We also tried to find some implications from existing research on enterprise agility; however, prior research on enterprise agility is either conceptual in nature and not supported by empirical evidence (e.g. Overby et al. 2006; Seo and La Paz 2008), or too abstract to provide practical prescriptions (e.g. Holmqvist and Pessi 2006; Zain et al. 2005), which might not be instrumental in developing instructions for operational agility. Although some guidelines might be derived from recent research on enterprise agility (e.g. Tan et al. 2010), they are still too general to provide specific instructions to attain operational agility. Given the indispensible role of operational agility in modern competitive environment, it is an imperative to investigate how to achieve operational agility.

The information processing view of firms (Galbraith 1973; Tushman and Nadler 1978) might shed light on attaining operational agility. Information processing view characterizes firms as information processing systems that are faced with various levels and types of task uncertainty. The objective of the firm is to develop information processing capabilities that facilitate the right amount of information needed to cope with uncertainty and achieve desired performance. The focus of the information processing view on task uncertainty as a basis for organization is well suited for capturing the unique nature of business process that should be considered in attaining operational agility. As uncertainty that stems from the unique nature of business process (Mani et al. 2010) might become a hindrance for firms to sense and respond to market opportunities readily, how to attain operational agility might hinge on how to develop appropriate information processing capabilities to reduce uncertainty facing business process (Gattiker 2007).

Using a case study of Haier, one of the largest producers of household appliances in China with successful management of order fulfillment processes filled with uncertainty, the purpose of this research is to examine the approach to operational agility. Specifically, we draw on the lens of information processing view of firms to investigate the development of information processing capabilities, which, subsequently, are enacted for the attainment of operational agility in a turbulent business environment. Research on information processing view has emphasized the central roles played by IT-enabled information processing networks (e.g. Ahuja and Carley 1999; Kwon et al. 2007) and organizational controls (e.g. Egelhoff 1991; Grant 1996) in influencing how information processing capabilities are developed. Thus both of them are examined in this research. By doing so, the study attempts to fill the theoretical gap aforementioned. While there is lack of practical and concrete instructions for attaining operational agility that is considered to be indispensible for business success in modern competitive environments, the present study provides a valuable attempt in deriving implications for operational agility. Accordingly, the research question that this study aims to answer is

How to develop information processing capabilities to attain operational agility in a turbulent business environment?

Literature Review

Operational Agility

Operational agility is defined as "the ability of firms' business processes to accomplish speed, accuracy, and cost economy in the exploitation of opportunities for innovation and competitive action" (Sambamurthy et al. 2003, p. 245). It reflects the agile practices at business process level, thus it is also named "business process agility" in some studies (e.g. Raschke 2007; Raschke and David 2005). It is of great value to study for a number of reasons: (1) Modern business environment necessitates operational agility (Sambamurthy et al. 2003). As the contemporary operating conditions become increasingly turbulent due to factors such as hyper-competition, globalization, time-to-market pressures, and technological advancements (McAfee and Brynjolfsson 2008; Overby et al. 2006), firms improve business processes and redesign the ineffective ones (Malone et al. 1999) to attain operational agility to maintain competitive advantage. (2) Uncertainty that is rooted in the nature of business process (Mani et al. 2010) requires firms to be agile operationally. Business process is unique in its task environment, task interdependence, and task characteristics which result in task uncertainty (Tushman 1979). The operating conditions become worse when there is a great amount of uncertainty, which reinforces the imperative to attain operational agility. (3) Operational agility is especially crucial for firms relying heavily on their business processes in competition, such as manufacturing firms (e.g. Kim and Lee 1993; Voss 1995). This is obvious because ineffectiveness and inefficiency of business processes of these firms are fatal in their businesses.

As its vital role in enabling business success, the concept of operational agility has garnered considerable research attention over the past five years (e.g. Alexopoulou et al. 2008; Raschke 2007; Raschke and David 2005; Seethamraju and Seethamraju 2009; Tallon 2008; Wu and Li 2008). The majority of operational agility research centers on examining the antecedence of operational agility. For example, in Sambamurthy et al. (2003)'s conceptual study, information technology (IT) is posited as an enabler of operational agility. The paper analyzes two sources of operational agility enabled by IT: on one hand, IT can be applied to establish electronic communication channels which enable rapid and up-to-date supply of comprehensive information for more informed decision making (Amit and Zott 2001); on the other hand, IT also can be used to drive the modularization and atomization of business processes and enable combination and recombination of existing business processes to create new ones (Malone et al. 1999). Meanwhile empirical research on operational agility, such as the research investigating the effects of a firms' IT infrastructure on operational agility (Raschke 2007), the study examining the relationship among managerial IT capabilities, environmental dynamism, technical IT capabilities and operational agility (Tallon 2008), and the research exploring the mediating effects of operational agility on the relationship between IT capability and firm performance (Wu and Li 2008), all apply variance models to investigate the impacts of antecedent constructs on operational agility. Yet, despite the growing body of research, an important question has not been answered: how to achieve operational agility? Without practical and concrete instructions derived from an empirical study for attaining operational agility, theoretical advancement in research on operational agility is hard to achieve. Thus we intend to fill this important theoretical gap by providing a process model of operational agility.

Since operational agility is one component of enterprise agility, we tried to seek implications from research on enterprise agility; however, it might not be instrumental to offer prescriptions for operational agility mainly due to three reasons. First, the existing prescriptions on enterprise agility are intrinsically conceptual and not validated empirically (Tan et al. 2009). Although many studies provide plenty of insights for enterprise agility, such as the research investigating the facilitating role of knowledge and process oriented IT systems (Overby et al. 2006) and the study discussing the IT capabilities that enables agility (Weill et al. 2002), the propositions of these studies are not empirically validated (Tan et al. 2009) which hinders derivation of practical implications for operational agility. Secondly, abstract nature of most of existing prescriptions impedes the development of concrete instructions (Tan et al. 2010). These prescriptions are too abstract in that they are based on broadly defined IT constructs, such as digital options (Sambamurthy et al. 2003) and incremental systems implementation (Holmqvist and Pessi 2006). Finally, although some guidelines might be derived from recent research on enterprise agility (e.g. Tan et al. 2010), they are still too general to provide specific instructions to attain operational agility since the nature of business process is not accounted for. Operational agility reflects the agile practices at business process level, which necessitates the consideration of the nature of business process under investigation. Thus the existing research on enterprise agility fails to provide implications for attaining operational agility. Our study will present as a valuable attempt to provide practical and concrete instructions for attaining operational agility. We define operational agility in the context of order fulfillment as the ability to achieve accurate customer demands, cost economic coordination, and rapid production, which is adapted from Sambamurthy et al. (2003)'s definition. Next, we review the information processing view of firms to develop a sound theoretical lens to investigate the attainment of operational agility.

Information Processing View

The information processing view of firms (Galbraith 1973) characterizes firms as information processing systems that are faced with various levels and types of task uncertainty. The objective of the firm is to develop information processing capabilities that facilitate the right amount of information needed to cope with task uncertainty and achieve desired performance. Two important constructs are proposed in information processing view: information processing requirements and information processing capabilities. It further posits that firms will obtain optimal performance when there is a fit between information processing requirements and information processing capabilities. This perspective is particularly appropriate for studying operational agility. Given that uncertainty stemmed from the unique nature of business process (Mani et al. 2010) might become a hindrance for firms to sense and respond to market threats and opportunities readily, it is necessary for firms to develop proper information processing capabilities to reduce uncertainty (Tushman and Nadler 1978) and enable more informed decision making (Leifer and Mills 1996). Proper information processing capabilities that fit information processing requirements allow firms to acquire relevant, accurate, and comprehensive information in a timely and cost economic manner, so that firms are capable to detect market changes and respond to the changes more effectively and efficiently. Thus the information processing view of firms offers a valuable lens to investigate the attainment of operational agility.

Existing research on information processing view focuses on evaluating the fit between a firm's information processing requirements and its information processing capabilities (e.g. Fairbank et al. 2006; Flynn and Flynn 1999; Gattiker and Goodhue 2004; Mani et al. 2010; Premkumar et al. 2003), however, how to develop information processing capabilities is not answered by prior studies. For example, most of existing research applies a quantitative approach to assess information processing capabilities, such as the research investigating the level of information technology support in the procurement life cycle (Premkumar et al. 2003), the study examining different information processing design choices in risk management (Fairbank et al. 2006), and the research exploring various information processing alternatives in manufacturing environments (Flynn and Flynn 1999). These studies shed little light on the underlying mechanisms through which information processing capabilities can be developed. Given the significant role of information processing capabilities in enabling operational agility and the little knowledge on how these capabilities can be developed, our research attempts to fill this gap of the theoretical lens through developing a process model of developing routinized information processing capabilities for operational agility in a turbulent business environment. We provide literature review on information processing requirements and information processing capabilities in following sections.

Information Processing Requirements

Information processing requirements of a firm can be defined in terms of the amount of information about organizational activities that is collected, processed, and disseminated by organization actors to address task uncertainty (Mani et al. 2010). Existing literature suggests three sources of uncertainty, and thus of information processing requirements: task environment, task interdependence, and task characteristics (Gattiker 2007; Tushman and Nadler 1978). The environment is usually seen as a source of uncertainty since areas outside the firm are less likely to be controlled and are therefore potentially unstable (Tushman and Nadler 1978). One particular important contributor to uncertainty from environment is the environmental dynamism (Mani et al. 2010). The more dynamic the environment, the greater the uncertainty faced by the focal firm. This may be exemplified by the sales environment where customers' demands keep changing. The degree to which a department or subunit is dependent upon others in order to conduct its task effectively is also considered as a source of uncertainty (Gattiker 2007) since this interdependence is associated with the need for effective coordination and joint problem solving (Tushman and Nadler 1978). The greater interdependence among different departments, the greater the uncertainty faced. Sales and production planning that requires tight coordination among diverse departments is a highly interdependent task which exemplifies this idea. Task characteristics, of course, are significant sources of task uncertainty (Gattiker 2007). Task complexity is one important dimension of task characteristics (Gattiker 2007). Some research prefers to use level of analyzability and variety to define task complexity (e.g. Mani et al. 2010), while others choose the number of factors and their interactions to define this construct (e.g. Premkumar et al. 2003; Ramamurthy 1990). The latter may be reflected in manufacturing process in which production task includes manufacturing various types of and large number of products. Thus this complex product structure results in great amount of task uncertainty. In this study, we will examine the influence of different sources of information processing requirements upon the development of information processing capabilities for operational agility.

Information Processing Capabilities

Information processing capability is defined as the ability to gather, synthesize, and disseminate information properly to cope with task uncertainty and achieve desired performance (Galbraith 1973; Mani et al. 2010). Review of information processing view literature suggests that IT-enabled information processing network (e.g. Ahuja and Carley 1999; Fulk and DeSanctis 1995; Kraut et al. 1999; Kwon et al. 2007; Wiesenfeld et al. 1999) and organizational control (e.g. Egelhoff 1991; Grant 1996; Leifer and Mills 1996; Nelson and Winter 1982; Ouchi 1979; Tushman and Nadler 1978) are two determinants of information processing capabilities. Information processing network is defined as a dynamic network-based information processing structure which operates as a coordination mechanism that transcends formal hierarchy (Kwon et al. 2007). Organizational control is defined as all attempts to motivate individuals to behave in a manner consistent with organizational objectives (Ouchi 1979).

Information processing networks often assume the role of backbones that support information and knowledge-based activities within and across firm boundaries (Owen-Smith and Powell 2004). Since effective information gathering, synthesizing, and disseminating of an information processing network is essential for survival and competence (Kodama 2005), firms should found and refine information processing networks to maintain an optimal information flow (Kwon et al. 2007). With the step-shift advances in IT over the past few decades, the potential of IT in creating and maintaining effective information processing networks has been demonstrated by researchers and practitioners (e.g. Fulk and DeSanctis 1999; Jarvenpaa et al. 1998; Kraut et al. 1999; Kwon et al. 2007; Wiesenfeld et al. 1999).

Many studies have investigated the structure of information processing networks (e.g. Ahuja and Carley 1999; Kwon et al. 2007). The shape and structure of an information processing network depict the patterns through which organizational communication is expedited and information is processed (Ahuja and Carley 1999). Existing research on the structure of information processing networks has examined the level of hierarchy and degree of centralization of information processing networks (e.g. Ahuja and Carley

1999; Kwon et al. 2007). While an information processing network with high level of hierarchy and centralization is well suited to tasks that are routine and with low levels of interdependence, the information processing network with low level of hierarchy and centralization is more efficient in dealing with task with greater amounts of uncertainty (Ahuja and Carley 1999). Accordingly, we draw on the constructs of centralization (Freeman 1979) and hierarchical levels (Hummon and Fararo 1995) to investigate the structure of IT-enabled information processing networks. Centralization indicates the extent to which a network or group is organized around its focal point (Freeman 1979). A centralized network may reflect that information is concentrated in the focal point of the network. Hierarchical levels are reflected by the number of levels one must go through in order to obtain information (Hummon and Fararo 1995). The existence of hierarchical levels indicates that members must go through someone to obtain information rather than directly obtaining information from the source.

Organizational controls have inherent information processing properties (Grant 1996; Ouchi 1979; Turner and Makhija 2006; Tushman and Nadler 1978). Although information processing networks facilitate firms to process information in a certain pattern (Ahuja and Carley 1999), it does not account for the problem of partially congruent objectives shared by individuals or units (Ouchi 1979). Individuals or units tend to behave in a manner that might not be consistent with organizational goals when there are inconsistent objectives. In this case, it is less likely for firms to gather, synthesize, and disseminate information effectively and efficiently. Thus, organizational controls are implemented to solve the problem of partially congruent objectives (Ouchi 1979), which, in turn, influences how information is processed within the firm (Makhija and Ganesh 1997).

Organizational controls can be classified into four control modes—process control, outcome control, clan control and self control (Kirsch 1997). In process control, rules and procedures are pre-specified, which, if followed, will lead to desired outcomes. Rewards will be provided based on how well procedures are followed (Kirsch 1997). Firms implement process control when proper behaviors are known to the controller (Eisenhardt 1985). Outcome control specifies desired goals. Rewards will be offered if those goals are achieved (Kirsch 1997). Firms implement outcome control when outcomes are measurable (Eisenhardt 1985). Clan control is exercised via promulgating common values within a group of individuals who are dependent on one another and who share a set of common goals (Ouchi 1980). Behavior that is inconsistent with these norms and values is sanctioned, while consistent behavior is rewarded (Ouchi 1979). Firms implement clan control when neither outcomes are measureable not proper behaviors are known (Ouchi 1979). In self control, individuals define their own goals and processes for the task, and then proceed to self-monitor, self-reward, and self-sanction (Manz et al. 1987). These goals and processes that may or may not be formally documented emanate from the individual (Kirsch 1997). The antecedents of self control identified in prior research include ambiguous individual performance evaluation, individual abilities, and task complexity (Kirsch 1997; Manz et al. 1987). Organizational controls are important to study the development of information processing capabilities for operational agility since they will influence how information is processed within the firm (Leifer and Mills 1996).

To sum up, the literature on information processing view of firms suggests that the development of information processing capabilities may be the key to attaining operational agility for firms dealing with task uncertainty that stems from the unique nature of business process. This is because information processing capabilities help firms to reduce task uncertainty (Galbraith 1973), which allows firms to sense and respond to market opportunities in a more accurate, rapid and cost economic manner. The process of developing information processing capabilities can be manifested by the establishment of information processing networks and implementation of organizational controls. Applying this body of knowledge as a theoretical lens to analyze the case of Haier, a process model of developing routinized information processing capabilities for operational agility in a turbulent business environment is inductively derived to address the research question set forth at the beginning of the paper.

Research Methodology

The case research methodology was adopted to investigate the research question aforementioned for a number of reasons. First, the research question is a "how" question that is appropriate to explore through case studies (Walsham 1995). Second, both information processing capabilities and operational agility are complex and multi-faceted phenomena that are embedded in organizational context (Pentland 1999), which makes it more suitable to examine the phenomena through relevant stakeholders' interpretations (Klein and Myers 1999) rather than a quantitative approach.

Accordingly, two conditions form the basis for case selection: (1) business processes under investigation in the case organization must face great amount of uncertainty that necessitates appropriate information processing capabilities; (2) the case organization should ideally have developed various proper information processing capabilities to reduce uncertainty facing business processes, which, in turn, enacted for attainment of operational agility. The case of Haier, one of the largest producers of household appliances in China with successful management of order fulfillment processes filled with uncertainty is particularly appropriate for this research as the success of Haier in order fulfillment hinges on developing appropriate information processing capabilities to attain operational agility.

We followed the theory-building process as prescribed by Eisenhardt (1989) to design and conduct this study. One of our authors has been tracing the development of Haier for 6 years and collected large amount of qualitative data as part of other studies. Before we entered the field, we conducted several discussions to identify a priori specified set of themes that were potentially relevant to the research question. An archival analysis that took around two months complemented the discussions. Since the case company is very distinguished in China, a large amount of archival data could be found from online documents, websites and books. Meanwhile we reviewed the literature of information processing view of firms and operational agility to predict certain relationship between theoretical lens and our phenomena. Accordingly an initial set of pertinent themes (such as sources of information processing requirements, information processing networks, and organizational controls) was pre-identified based on the literature review. The archival data collected were systematically coded and categorized into these themes. Several researchers derived initial models which predicted the relationships among these themes according to the archival data. These models were shared among the researchers, which helped to consolidate the similarities of these models. This resulted in the formation of our preliminary model which served as a "sensitizing device" (Klein and Myers 1999; Pan and Tan 2011) to guide the following data collection and analysis (Eisenhardt and Graebner 2007).

Onsite data collection was conducted after access to case company was granted in September 2010. A series of group interviews with average 3 informants per group were conducted with the middle and top management of IT department, including CIO and department directors. According to Fontana and Frey (2000), group interview can produce "rich data that are cumulative and elaborative; they can be stimulating for respondents" (p. 652). Thus, the type and range of qualitative data generated from group interviews are often deeper and richer than those collected from one-to-one interviews, which helps achieve a more comprehensive view toward the complex phenomena we attempt to study. Interviews were based on topic guides, which demonstrated relevant probes at appropriate junctures (Pan et al. 2007). Topic guides were tailored to each interview. Each informant was assured of the confidentiality of the data provided, especially when potentially sensitive information is sought (Walsham 2006). The strategy of multiple investigators, which enhanced the creative potential of the study as well as confidence in the findings (Eisenhardt 1989), was used for each interview. The 9 group interviews, taking an average of 90 minutes were recorded digitally and later transcribed to form an equivalent single document of more than 100 pages (front size 10pt and single line spacing). The group interviews were complemented by 2 individual interviews with the informant who was the most familiar with the process we were studying. The individual interviews also served to confirm our understanding formed during group interviews. Site visits to Haier's facilities in headquarter was arranged and around 60 photos were collected during site visits. Whereas the interviews formed the primary source of data, they were corroborated by other secondary data such as internal publications, organizational documents, and field notes. Multiple data collection allows triangulation offering stronger substantiation of constructs and hypotheses (Eisenhardt 1989).

Data analysis was conducted at the same time as data collection to benefit from the flexibility offered by case study method (Eisenhardt 1989). The data collected from each interview was coded and arranged according to the pre-identified themes aforementioned. A combination of a narrative strategy and a visual mapping strategy was adopted to manage the large amount of collected data (Langley 1999). Three most important processes of order fulfillment reflected by three distinctive tasks (i.e. order forecasting, sales and production planning, and goods production) were identified. Then we divided empirical data into these processes to examine how information processing capabilities were developed in each process and subsequently enacted for operational agility. A series of diagrams summarizing the empirical data and a detailed narrative were generated to facilitate data analysis. Next, we compared these diagrams and the narrative with relevant literature to refine the preliminary model. Data analysis followed an iterative process between empirical data, relevant literature, and the emerging model to analyze collected data until theoretical saturation was reached, in which the findings of case study were comprehensively explained and no additional data can be collected or added to improve the emergent model (Eisenhardt 1989). The arrival of this stage was confirmed by two experienced case researchers.

We conducted another round offsite archival analysis after we came back from the field. The purpose of this archival analysis was to detect any discrepancies between data collected and the emergent model, as well as to fine tune our model so that inconsistencies were eliminated. In order to achieve this end, additional data including websites data, published articles, and books were collected through leads provide by the interviewees. By scanning through all the data repeatedly, a number of small discrepancies were found and confirmed by multiple researchers. Then the model was revised after extensive discussions were conducted and agreements were achieved among researchers. We spent four months to conduct the offsite archival analysis to ensure highly consistency between the derived model and all the data collected.

Case Description

Organizational Background

Haier Group started as the Qingdao Refrigerator Factory in the early 1980s, originally an importer of refrigerator production technologies from Germany. Since the current CEO Ruimin Zhang took over the company in 1984, Haier has grown from a near-bankrupt enterprise with deficit financing of up to US$230,000 due to poor management to a prospering Chinese multinational corporation over the past few decades. Nowadays, Haier Group has over 240 subsidiary companies, more than 110 design centers, plants and trading companies as well as over 50,000 employees throughout the globe. From the statistics of Euro-monitor, Haier was ranked third in Global Major Appliances Millionaires Club 2010 ranking by unit volume, with the strongest growth of 13% among the top four appliance companies.

With the fast expansion of the company, Haier faced a myriad of challenges. For example, one challenge came from its increasing product lines. Haier's product range had developed from a single line of refrigerators to 96 product categories with over 15,100 different specifications. As the products diversified, management of the large product lines became extremely difficult. Meanwhile, Haier had established an extensive sales network globally to facilitate the sales of its products. Key partners in respective markets included Sunning and Gome chain stores in China, 10 leading chain stores in America, 12 of the top 15 chain stores in Europe, and 10 retailers in Japan. Among them, sales network in China contributed most to Haier's global revenue and was particularly complicated. The company decomposed the sales network in China into over 33,000 minimal sales network grids. These network grids were recomposed to form over 5,000 management units. Each unit was occupied by one salesperson that was responsible to handle sales issues of customers falling into the unit. Over all there were more than 10,000 salespersons constituting an intricate sales network in China. The geographical distribution of the sales network covered cities in south China such as Guangzhou and Shenzhen as well as cities in north China such as Changchun and Harbin. With this large scale of sales force and the broad geographical distribution, detecting and responding to market demands accurately and efficiently relied heavily on the capability to process information from enormous distributed point of sale. Management of the extensive sales network was faced with great amount of uncertainty, which posed another big challenge to Haier.

Despite various challenges, the constant endeavors in creating and improving innovative management practices guarantee Haier's success, which also enables the transformation of a near-bankrupt enterprise to a thriving multinational corporation. Started from April 26th, 2007, Haier began its new journey toward improving its business processes and launched the program of "1000 days information revolution", which intended to restructure 2000 to 2500 business processes under the support of IT. Through this program, the company integrated its fragmented information systems and achieved the alignment of IT and business processes to create innovative business processes. Order fulfillment processes, which are among the business processes improved during this program, form the context of this research. Order fulfillment is commonly defined as the complete process from point of sales inquiry to delivery of a product to the customer. Order fulfillment in Haier goes through three main business processes sequentially and iteratively: order forecasting, sales and production planning, and goods production. These processes are crucial to order fulfillment and constitute the targeted business processes to examine in this study.

Based on our review of the literature on information processing view of firms, we center on three relevant themes including sources of information processing requirement, the process of developing information processing capabilities—manifested in establishing information processing networks and implementing organizational controls, and the consequences of developing process – focused on information processing capabilities developed and their roles in achieving operational agility. Under the background of order fulfillment, three sequential business processes aforementioned are examined. We present our data according to the sequence of these processes in the subsections that follow.

Forecasting Process

Order fulfillment in Haier began with the order forecasting process which aimed to acquire accurate customer demands. This process included acquiring customers' orders for production and forecasting customers' future demands for procurement. It was extremely challenging to cope with the process for the reason that customer demands kept changing in contemporary business environment. The requirement of specific products would change suddenly due to lots of factors, such as competitor's release of substitutable products or consumer's preference change. Meanwhile the large sales force in Haier made this process more complex by increasing the difficulty of tracing and monitoring the performance of salespersons. Thus it was imperative for the company to find solutions to deal with these challenges.

In order to acquire accurate customer requirements, Haier established direct information exchange channels between salespersons in point of sale all over China and sales department in headquarter based in Qingdao. One example is the salesperson portal. In the past, market demands gathered by salespersons went through several levels of hierarchies to approach sales department in headquarter, through which information became distorted. This phenomenon could be vividly described as the bullwhip effect (Lee et al. 1997). The salesperson portal solved this problem by enabling direct information exchange between salespersons that are close to local market and sales department in the headquarters. Another example is the usage of SMS to provide daily feedback information to salespersons.

Haier also relied on performance management program to motivate salespersons to actively communicate with their customers to ensure the accuracy of customer needs acquired. The performance management program was named as salespersons' "individual goal combination"[1] in Haier. Salesperson's performance was evaluated and classified based on the extent to which the performance is consistent with organizational goals. There were several evaluation criteria, such as accuracy rate of order forecasting and order fulfillment rate. While desired performance would be rewarded, undesirable outcome was punished monetarily. This program enhanced salesperson's responsibility to ensure the accuracy of market demands collected. Furthermore, salespersons were given sufficient discretion to perform their tasks, which guaranteed the flexibility of dealing with demand variability. This was reflected in the belief that "every salesperson is a Strategic Business Unit (SBU)" propagated by the company. Guided by this belief, salespersons developed their own ways to detect customer needs. For example, they could anticipate customer's demands based on customer's sales and inventory. Providing tools to support order forecasting was helpful in improving order accuracy. An order forecasting system which integrated complicated forecasting models and large amount of sales data was developed to assist order forecasting.

The direct information exchange channels between salespersons in point of sale and sales department in the headquarters largely prevented information distortion during the information transfer process; meanwhile, salespersons were strongly motivated to acquire customer demands. Through above mechanisms, Haier's ability to detect market requirements is enhanced. Relevant themes identified in forecasting process are summarized in table 1.

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[1] "Individual goal combination" is a performance management program which evaluates employees' performance and provides incentives based on their performance. It is a system of assigning incentives-based responsibility to staff to ensure the quality of products delivered to their customers.

Table 1. How Haier Developed Information Processing Capabilities for Operational Agility in Forecasting Process	
Source of Information Processing Requirement	**Environmental Dynamism** "*If every customer is a flying target, then the number of flying targets is countless. It is impossible to rely merely on a small number of decision makers to understand all the flying targets thoroughly since every target is different. Therefore, it is imperative for each employee to face market directly. Everyone has to find his or her own order and market; otherwise we will not prevail in marketplace.*" [Haier CEO (Yong 2008, p27)] *"There is a common problem with household appliance industry. Most customers expect to get the products immediately when they come to us. If we don't have sufficient inventory, they will turn to others. They will not spend a few days to wait for us."* [Director of Department 2]
Information Processing Network	*"We provided a portal for product representatives (salespersons). They can not only make sales orders, but also view sales information of their own customers … They can see the amount of income and loss every day. They also can see new tasks assigned by the headquarters. If they have any problems, such as some problems in customer's model machine, they can feedback to the headquarters directly."* [Director of Department 1] *"The information of performance evaluation result will be sent via SMS to every salesperson daily. By doing this, even though they are on a business trip, they still can know their performance, so that they can adjust accordingly."* [Manager of Strategy Department]
Organizational Controls	**Outcome Controls** *"If you can fulfill your plan completely, you can get all your salary and season rewards. If you want to get your salary, you have to make a sound sales plan, to sell profitable products and to sell fast."* [Manager of Department 2] *"Evaluation toward employees' performance is characterized by personal, immediate, quantitative, open, outcome-driven, monetary positive incentives and "negative incentives". Employee's salary is calculated according to goal fulfillment and performance."* (Yong 2008, p43) **Self Controls** *"Except for selling fast, selling more, and selling profitable products, we still have one principle, which is to be independent in managing the business and responsible for one's own profits and losses."* [Manager of Strategy Department] *"The company offers employees with sufficient resources. They are empowered to use and manage one's resources independently. Thus, each employee becomes a 'mini company'".* (Yong 2008, p18)
The role of Information Processing Capability	*"Through implementing these mechanisms (to manage salespersons), our salespersons are just like engines with extremely strong power. Because these mechanisms are very motivating."* [Haier CIO] *"The informationized process is a high-responsiveness process. Any instant requirement from customer or any subtle change in local market will be reflected in each step of the process."* (Yong 2008, p57)

Planning Process

Once sales orders were determined, sales department initiated the sales and production planning process with other departments including production, procurement, logistics, finance, design, etc. The objective of this process was to generate a congruent plan to guide the actions of diverse departments. It was particularly challenging to coordinate their actions due to diverse requirements and goals of different departments. One simple example was that sales department considered whether their sales orders could be fulfilled while production department cared about how many products it could produce with limited resources. It was possible that the sales orders generated by sales department exceeded the capacity of production department. Thus diverse situations of different departments placed a big challenge of planning and required a large amount of interaction and communication across departments.

Table 2. How Haier Developed Information Processing Capabilities for Operational Agility in Planning Process	
Source of Information Processing Requirement	**Task Interdependency** *"Everyone must pay close attention to the whole process. For example, logistics department must communicate with development department about components modulization … In fact it is a coordination process, including order delivery, production progress, and product delivery."* [Director of Department 3] *"Originally, each department had its own IT infrastructure to support its operation. However customer order went across different departments (which cannot be handled by the original structure). Sales department acquired order from customer, then order was transferred to procurement and production department; it reached finance department at the end to settle payment with customer."* (Yong 2008, p49)
Information Processing Network	*"When the company becomes larger, responding slowly (to customer demands) is undesirable. To be fast, we have to use information technology to achieve process synchronization … All the departments, including salespersons, production staff and research staff will receive orders at the same time."* [Director of Department 4] *"To achieve system integration, we made several changes to the existing information systems technically, such as establishing a bus sharing platform and the release of GVS."* [Manager of Infrastructure Operation and Maintenance Department]
Organizational Controls	**Process Controls** *"For the process between forecasting and producing, we use the "161 week order" mechanism to adjust the frequency of the process and improve its efficiency … After using this mechanism, the cycle of order fulfillment is reduced from 40 days to 17 days. Actually we control the frequency of our business."* [Manager of Department 2] *"We have a set of procedures and mechanisms to cope with coordination between sales and operation. Sales persons will report results of order prediction on every Monday; the headquarters will adjust the results of order prediction on every Tuesday; then estimate short-term order prediction on every Wednesday; estimate long-term order prediction on each Friday."* [Manager of Department 1] **Clan Controls** *"Now we emphasize the goal of the whole process, from acquiring orders to the whole supply chain. We have to unify our goals. Only when the unified goal is achieve, the value of each individual can be realized."* [Director of Department 4] *"We fostered sound organizational culture through promoting teamwork. Our designers, marketing staff, manufacture persons, salespersons, and customers joined together to analyze market demands. Our sound organizational culture was the foundation of our competitiveness."* [Haier CEO (Yong 2008, p78)]
The role of Information Processing Capability	*"Technically, we implemented an information sharing platform. It helps to save money, save time and save efforts. Saving time means accessing to information is very fast. Saving money actually means information is shared and there is no necessary to purchase additional devices. In the past some tasks took us lots of efforts, such as we had to negotiate a lot for the procurement task and it took us 40 days to deliver. But now it only takes one day."* [Director of Department 3] *"Each employee has a picture of the whole organization in mind. They understand how each part is connected. If you ask them where the order comes, he will tell you who your customer is. If salesperson cannot collect payment, nobody can achieve salary."* [Professor of Management and Sociology in Wharton, University of Pennsylvania (Yong 2008, p78)]

The key to perform this task was to facilitate tight communication and information exchange across departments. To achieve this end, Haier restructured its IT infrastructures and integrated existing information systems to boost extensive information exchange across departments. For example, the company integrated a myriad of existing systems and established the data sharing platform to expedite information sharing. The Global Value System (GVS), which is Haier's ERP system, also played a pivotal role in facilitating timely information exchange between departments.

To further guarantee sufficient communication and coordination across departments to support sales and production planning, Haier established a series of clear procedures for coordination. These procedures formulated concrete time and activities to be performed by specific department as well as individual. For instance, the company conducted routine cross-departments meeting every Wednesday to communicate and negotiate sales and production issues. Apart from the clear procedures, the company developed an order review system to check the alignment between requirements and constraints of different departments so that the outcomes of planning were accurate and feasible. Except for these formal mechanisms, Haier's collective culture played a key role in facilitating the sales and production planning. The company propagated common organizational values among departments. It emphasized individual obedience to "one common goal" of the company so that individual would benefit more when the goal of the company was accomplished. This corporate and collective culture facilitated sales and production planning by solving conflicts across departments which cannot be solved by pre-specified procedures.

Overall the environment was built to facilitate fluent information exchange across departments. Effective sales and production planning relied heavily on a high amount of interaction and communication across departments. With extensive information exchange, the coordination of allocated resources, activities, and roles across departments was improved. Thus the company was capable to achieve cost economic coordination. Relevant themes identified in planning process are summarized in table 2.

Production Process

The outcomes of sales and production planning process served as guidance of production process. The objective of this process was to manufacture various products to fulfill customer demands. As a household appliance giant with large product lines, production in Haier was extremely complex. This was because the production task required manufacturing various types and large number of products, meanwhile assembling various types and large number of elementary components into each item. Thus, how to manage the complex product structure in an effective and efficient manner raised a big challenge to Haier.

To cope with the challenge, information systems, such as the GVS, were used to support the information dissemination to the manufacturing plants. For example, when sales orders arrived, production department used GVS to transform the sales orders into production orders which were then sent to factories distributed in different regions. Accordingly, each factory deployed its own production plans based on its resources. Thus information of sales orders was transformed and distributed through information systems to approach each manufacturing plant.

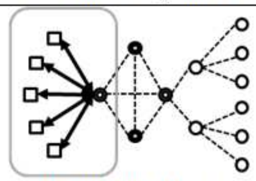
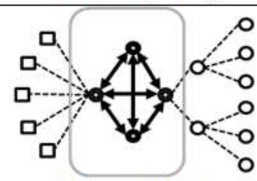
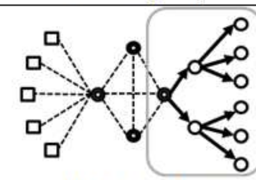
Accurate and rapid production relied on clear rules and procedures. Although the complex product structure was particularly tough to cope with, establishment of clear rules and procedures enabled division of the complex task into simple and orderly ones. These rules and procedures pre-specified detailed processes to be followed by individuals. Furthermore, information systems were also used to control and record the execution of the pre-identified procedures. Similar to the forecasting process, Haier implemented performance management program in production department, which served to motivate individuals. The performance of individual was evaluated and payment was provided based on the evaluation outcomes. Unlike evaluation criteria applied in salespersons' performance management, in production department, they implemented their own evaluation criteria.

Mechanisms implemented by Haier in this process facilitated accurate and rapid production. Through using information distribution channels and relying heavily on extensive procedures as well as performance management, information is processed in a way that supported the decomposition of complex production task into simple and orderly subtasks, which, in turn, enabled accurate and rapid production. Relevant themes identified in production process are summarized in table 3.

Table 3. How Haier Developed Information Processing Capabilities for Operational Agility in Production Process	
Source of Information Processing Requirement	**Task Complexity** *"Based on traditional data management point of view, it (the modules management system) is a very large components warehouse or modules warehouse. (In the past,) which component was universal, which one could be combined, did the inventory increase or decrease, all of these could not be observed directly. For manager and user, this problem was relatively complex."* [Director of Department 4] *"Currently, Haier receives more than 0.9 million sales orders from domestic and oversea market monthly. These orders involve more than 10,000 types of customized products, which require procuring more than 260,000 types of material." (Yong and Shaofei 2008, p285)*
Information Processing Network	*"The systems are used to confirm and distribute sales orders. After some manual adjustments, production orders will be transferred to factories on every Wednesday night. Production department of each factory will organize its production accordingly. All of these are implemented by systems."* [Technical Leader of Department 3] *"Our intranet covers all the factories. All information exchange is processed through information systems."* [Manager of Department 1]
Organizational Controls	**Process Controls** *"Production task is driven by production plans. All the relevant systems will be used to monitor and execute tasks such as execution of production orders, management of material and product inventory, quality management and shipment. Usually we provide operation instructions to guide the normative operation. Meanwhile business processes are maintained in GVS."* [Technical Leader of Department 4] *"The 'T mode' was created with the guidance of 'individual-goal combination'. It was used to specify each employee's daily work." (Shubo et al. 2007, p140)* **Outcome Controls** *"'Individual-goal combination' is applied to all the staff, including staff from supply chain and production department. There are specific performance management mechanisms for them. For manufacture persons, their performance is evaluated based on fulfillment of production goals."* [Director of Department 1] *"(The evaluation criteria for production department include,) first, deliver on time. Second, accuracy of order delivery. Furthermore, we also evaluate fulfillment of production capacity. For example, our production capacity is 5000 per day, but we only produce 4000 (which is undesirable). This can be considered as usage ratio of production capacity."* [Manager of Department 2]
The role of Information Processing Capability	*"We emphasize the efficiency of the whole supply chain, from the input of customer orders to output of products. The cycle is only around 21 days. I cannot remember the exact number, but it does improve a lot. Our delivery cycle is the best in our (household appliance) industry. Our delivery efficiency is quite high."* [Director of Department 4] *"We set up the '161 week order' mechanism in 2009. Some changes were made to our information systems accordingly. By doing this, we not only implemented the zero inventory management, but achieved high-responsiveness toward customer's demand."* [Manager of IT Infrastructure Management Department]

Discussion

To address our research question that how to develop information processing capabilities for operational agility in a turbulent business environment, we went through an iterative process between relevant literature, qualitative data, and the emerging model. Subsequently a process model of how routinized information processing capabilities are developed for operational agility (see Figure 1) was inductively derived. As our model suggests, three distinct routinized information processing capabilities are developed during order fulfillment processes, which, together, are enacted for operational agility. Given that this model was inductively derived from the Haier case, we present how the existing literature corroborates the model and how the model enriches our present understanding of operational agility.

Business Processes	Forecasting	Planning	Production
Sources of IPR[1]	Environmental Dynamism	Task Interdependency	Task Complexity
Information Processing Networks	 **Information Wheel** Established direct information exchange channels between salespersons and headquarter. Centralization: *High* Level of hierarchy: *Low*	 **Information Mesh** Established highly connected information exchange channels among different departments. Centralization: *Low* Level of hierarchy: *Low*	 **Information Tree** Established hierarchical information disseminating channels between headquarter and manufacturing plants. Centralization: *High* Level of hierarchy: *High*
Organizational Controls	**Impellent Controls** • *Outcome Control* Evaluated salespersons' performance and provided incentives to desired outcomes; • *Self Control* Provided discretions for salespersons to decide their own sales orders and tools to support order forecasting task.	**Collective Controls** • *Process Control* Established a clear procedure to coordinate activities and developed methodologies to facilitate planning; • *Clan Control* Cultivated the collective culture across departments.	**Objective Controls** • *Outcome Control* Evaluated employees' performance and provided incentives to desired outcomes; • *Process Control* Developed production plans to guide employees' activities and established clear rules and procedures to guide employees' routine work.
Roles of Routinized Information Processing Capabilities	**Information Sensitivity** Information sensitivity enables organization to ***achieve accurate market demands***.	**Information Fluidity** Information fluidity enables organization to ***achieve cost economic coordination***.	**Information Decomposability** Information decomposability enables organization to ***accomplish rapid production***.
Operational Agility	The ability to achieve accurate market demands, cost economic coordination, and rapid production in order fulfillment process.		

Notes:
1. Information Processing Requirement

Figure 1. Process Model of Developing Routinized Information Processing Capabilities for Operational Agility

Environmental Dynamism in Forecasting Process

The order forecasting process was filled with great amount of uncertainty stemmed from environmental dynamism (Lee and Grover 1999). One specific type of environmental dynamism is termed as demand uncertainty, which indicates the changes in demand for products and the inability to accurately predict these fluctuations (Premkumar et al. 2003). This characteristic captures one of the natures of contemporary business landscape where customer demands keep changing rapidly (Overby et al. 2006). The metaphor of "flying targets" from Haier's CEO attested this challenge facing with the company. Since the primary strategy for reducing demand uncertainty is the timely availability of relevant information (Premkumar et al. 2003), information processing capability fulfilling this goal is preferred.

The requirement of dealing with environmental dynamism drove the establishment of "**information wheel**" and the implementation of **impellent controls**. The naming of "information wheel" is based on the fact that salespersons in point of sale were connected with sales department in headquarter through information exchange channels directly, which is like a wheel in that all peripheral nodes are connected with the center directly. The information wheel is characterized by high level of centralization and low level of hierarchy. This structure is similar in spirit to the hybrid communication network in that it allows both efficiency and flexibility simultaneously (Brown and Eisenhardt 1998). The centralized structure is efficient when information interactions occur vertically (e.g. information sent from central nodes to peripheral nodes) (Ahuja and Carley 1999); low level of hierarchy representing a flatten structure is flexible in facilitating mutual adjustment between the center and peripheral nodes. To motivate salespersons in point of sale, the impellent controls were implemented, which comprise both outcome control and self control. Through developing the performance management program to evaluate salespersons' performance and provide incentives to desired performance, outcome control was executed (Eisenhardt 1985). Meanwhile, the company provided sufficient discretion for salespersons to perform their tasks and offered tools (such as the order forecasting system) to support their tasks, which reflects the execution of self control (Manz et al. 1987). These control mechanisms provided impellent forces to motivate salespersons in acquiring customer demands and thus are named as the impellent controls.

Consequently, the ability to detect real market demands was developed, which is named as the "**information sensitivity**". Through establishing the information wheel and implementing the impellent controls, the company attained the direct feed-forward from the marketplace. The information sensitivity is similar to the "market sensitivity" (Christopher 2000) in supply chain research, which is considered as a key determinant of agile supply chain. The information sensitivity enables the company to achieve accurate market demands. This information processing capability contributes to the sensing component of operational agility by enhancing the market intelligence capability (Overby et al. 2006).

Task Interdependency in Planning Process

The great amount of uncertainty that confronted the sales and production planning process mainly originated from task interdependence (Gattiker 2007) since this process required tight collaboration across departments. Actions taken within one department affect the actions and work outcomes of other departments (McCann and Ferry 1979) during this process. This interdependence among departments increases the likelihood that changing conditions in one department require other departments to adjust (Thompson 1967). To achieve this type of adjustment, each department should be aware of information about other departments (Gattiker 2007). Thus it is necessary to develop appropriate information processing capability to support the sales and production planning.

To cope with information processing requirement that emanated from task interdependence, the "**information mesh**" was established and **collective controls** were implemented. The "information mesh" could be built through establishing highly connected information exchange channels across diverse departments. The information mesh is characterized by low level of centralization and hierarchy. This structure is similar to the "small world" network (Kwon et al. 2007) or the organic communication network (Ahuja and Carley 1999). It supports routine communications among actors and enhances mutual dependence among interconnected nodes, especially when tight collaboration is desired for connecting value chains within the organization (Newman 2004; Porter 1985). To motivate actors from diverse departments to perform the planning task, the collective controls were implemented. This type of control consists of process control and clan control. The process control was implemented through establishing a clear procedure to coordinate activities across departments and developing methodologies (such as the order review system) to facilitate planning (Eisenhardt 1985). The clan control was implemented by propagating the "one common goal" belief and cultivating the collective culture among departments (Ouchi 1979; Ouchi 1980). These control mechanisms were implemented to facilitate collective adjustments among different departments and thus are termed as the collective controls.

Through above mechanisms, the ability to facilitate integrated information flow across departments is developed, which is named as the "**information fluidity**". While existing research has found that information flow integration between firms in a supply chain enhanced operational efficiencies through improved coordination of allocated resources, activities, and roles (Lee et al. 2000), our findings show that the integrated information flow also plays the crucial role in facilitating coordination across diverse departments within organization. With improved allocation of resources, activities and roles across departments, the company is capable to attain cost economic coordination. The information fluidity contributes to the sensing component and the responding component (Overby et al. 2006) of operational agility in that fragmented information from diverse departments is integrated to achieve a holistic view of environments and coordinated responding plans are created to guide organizational actions.

Task Complexity in Production Process

Our model suggests that uncertainty mainly stemmed from task complexity (Lee and Grover 1999) in production process. Some research prefers to use level of analyzability and variety to define task complexity (e.g. Mani et al. 2010), while others choose the number of factors and their interactions to define this construct (e.g. Ramamurthy 1990). The latter is more appropriate to describe the production conditions in the case company where various types and large number of products are produced. This complex product structure constitutes one of the key determinants of production complexity (Calinescu et al. 1998). As product structure becomes complex, more distinct information cues must be processed. Thus, this complex task is associated with the needs for appropriate information processing capability.

The "**information tree**" was established and **objective controls** were implemented to fulfill information processing requirement. The "information tree" could be built through establishing hierarchical information disseminating channels between headquarter and manufacturing plants. This structure is characterized by high level of centralization and hierarchy. It is similar to the "moderate scale free" network (Kwon et al. 2007) or the mechanistic communication network (Tushman 1979). Among systems of a given size and complexity, it requires less information exchange among actors (Simon 1977) than do the information mesh. The dispersed manufacturing plants of the case company rely on this communication hierarchies for efficiency in communication and coordination (Ahuja and Carley 1999). Accordingly, the objective controls (Leifer and Mills 1996) were implemented to coordinate among members during the production process. The objective control is a form of cybernetic control mechanism (Hofstede 1978) based on rules and measurement. Outcome control and process control make up the objective controls. To implement outcome control, employees' performance is evaluated and incentives are provided to a desired outcome (Eisenhardt 1985). Process control is executed through developing production plans to guide individuals' activities and establishing clear rules and procedures to guide daily work (Kirsch 1997). These control mechanisms allow the company to pre-specify desired behaviors as well as outcomes through which efficiency can be gained (Van den Bosch et al. 1999).

The information processing capability developed in this process is named as the "**information decomposability**", which reflects the ability to disseminate information in a manner that supports the division of complex task into simple and orderly subtasks. Through establishing the information tree and implementing the objective controls, the complex task can be decomposed into subtasks and coordinated by the actors so that they can connect sufficient know-how information to meet situational demands (Weick and Roberts 1993). With the proper division of complex task and orderly coordination of actors enabled by the information decomposability, the company is capable to perform the complex production task efficiently. The information decomposability contributes to the responding component of operational agility through enhancing the production capability (Overby et al. 2006).

Operational agility is defined as the ability to achieve accurate customer demands, cost economic coordination, and rapid production in the context of order fulfillment. Through developing information sensitivity, information fluidity, and information decomposability, firms could achieve accurate market demands, cost economic coordination, and rapid production in order fulfillment, as we have showed in previous sections. Since three information processing capabilities developed are iteratively applied in these business processes, they are routinized for repeated application. Thus our model suggests that operational agility can be attained through developing these distinct routinized information processing capabilities to cope with information processing requirements of the three business processes.

Conclusion

Theoretical and Practical Contributions

This study contributes to the literature in several ways. Firstly, this study could be considered as a valuable attempt to offer an empirical investigation on operational agility. Operational agility is vital to achieve business success in a turbulent business environment. It is of particularly importance to firms in China since the large-scale and complex market place in China requires firms to attain the ability of capturing market opportunities effectively and efficiently. Despite its significant role, existing research fails to provide concrete and practical instructions for attaining operational agility. This theoretical gap is fulfilled by the empirically grounded process model proposed in this study. By this means, this study serves as a sound basis for deriving concrete and testable propositions for the attainment of operational agility and makes meaningful contributions to operational agility literature.

Secondly, this research also contributes to information processing view of firms. Existing research on information processing view mainly focuses on evaluating the fit between a firm's information processing requirements and its information processing capabilities (e.g. Mani et al. 2010; Premkumar et al. 2003), however, how to develop information processing capabilities is not answered. Our research fulfills this theoretical gap by depicting the processes through which information processing capabilities are developed. Through this means, a number of theoretical constructs, such as three types of information processing networks, as well as the relationships between them that are pertinent to the development of routinized information processing capabilities for operational agility are identified. It is hoped that these theoretical constructs can form a foundation for future research on information processing view of firms.

Finally, the novel way of applying the classic organizational theory – information processing view of firms (Galbraith 1973; Tushman and Nadler 1978) – to investigate the emerging phenomena, which is the attainment of operational agility (Sambamurthy et al. 2003), is likely to inspire more future research that combines information processing view of firms and agility literature. Agility is decomposed into two components: sensing and responding (Overby et al. 2006). The sensing components rely on organizational capability in processing information from environments so that accurate understanding of environments can be attained. The responding components depend on capability in transforming raw information into an actionable plan and disseminating information to coordinate activities. Thus information processing view of firms provides a sound theoretical lens to investigate the research topic of agility including operational agility. We hope that this study can provide a sound example of combining information processing view of firms and agility literature and stimulate more efforts toward this end.

In terms of practical implications, this study is instrumental in providing concrete instructions to attain operational agility, which is especially significant for firms competing in large-scale and complex market places, such as the Chinese market. Our process model indicates that operational agility can be attainted through developing dissimilar routinized information processing capabilities to deal with information processing requirements facing business processes. More specifically, to develop routinized information processing capabilities for operational agility, firms should establish information processing networks and implement organizational controls based on information processing requirements. These implications may help organizations achieve operational agility in a turbulent business environment.

Limitation and Future Research

Given the large-scale of market and the high speed of changes in China, attaining agility is the key for firms to adapt to the environments. Thus conducting agility research in China becomes appropriate and necessary. Meanwhile, information processing capabilities enable firms to sense and respond to this turbulent environment more readily, the role of which gains particular significance in China. Future research can focus on providing more implications of attaining agility and developing information processing capabilities, especially under the background of China.

This research is not without its limitations. Although single case research methodology is a "typical and legitimate endeavor" in qualitative research (Lee and Baskerville 2003) and is adopted by many IS researchers (e.g. Kirsch 2004; Pan et al. 2007), its common criticism is the problem of generalizability or external validity (Walsham 2006) since it is impossible to achieve statistical generalization from a single case study. However, our finding is generalizable beyond its singular context for the reasons that our process model is inductively derived from empirical data on one hand; it is also corroborated by the theoretical propositions of prior research in management and IS literature. Thus the principles of "analytic generalization" (Yin 2003) are applied. Nevertheless, future research attempting to statistically test the propositions of this study is needed to better define the boundary condition of the process model. The second limitation concerns the retrospective nature of the interview data. A disadvantage of retrospective responses is that they may suffer from errors of recall. We have tried to minimize this effects by two means: on one hand, we chose informants who were personally involved in the process of developing information processing capabilities for operational agility (Pan et al. 2007); on the other hand, a systematic data verification procedure was followed to ensure data triangulation (Klein and Myers 1999).

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